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ELEMENTS

OF

AGRICULTURE.

ELFMENT S



AGRICULTURE.

E R O A T A

THE RIGHT HONOURABLE

JAMES STEWART MACKENZIE,

LORD PRIVY SEAL FOR SCOTLAND,

THE FOLLOWING ATTEMPTING A SCIENCE,

NOT LESS HONoured BY HIS ENCOURAGEMENT

THAN USEFUL IN ITSELF,

WITH DUE RESPECT AND GRATITUDE,

INSCRIBED

BY

HIS MOST OBLIGED

AND MOST HUMBLE SERVANT,

GEORGE FORDYCE.

ERRATA.

Page THE RIGHT HONOURABLE

10 JOIN Line 9 and 10 into one.

JAMES STEWART MACKENZIE

17 For Fossili read Fossile.

D^o For Earthly read Earthy.

24 Middle Column, Line 7, for found read form'd.

NOT LESS HONOURED BY HIS ENCOURAGEMENT

25 Middle Column, for Metaly read Metallic

26 For in a Soil, by, read to a Soil, it.

34 First Column, for Animal read Animal.

WITH DUE RESPECT AND GRATITUDE

RECEIVED



Y

HIS MOST OBLIGED

AND MOST HUMBLE SERVANT,

GEORGE FORDYCE.

PART I
ELEMENTS of CHEMISTRY, necessary
to be understood for the Explanation
of the Principles of AGRICULTURE.

M ECHANICS, Treat of the Properties
belonging indifferently to all kinds of
Matter.

CHEMISTRY, treats of those Properties
which belong to particular Bodies only, and do
not arise from their Organization.

PHYSIOLOGY, is the Doctrine of ani-
mated Matter.

SUBSTANCES combine together;

1st, **MECHANICALLY**, by being divided into
small Particles, and mixed by an *External Force*.

2^d, **CHEMICALLY**, by an Attraction of the
Particles of one Body to those of another.

The Particles of Bodies do not touch, but ad-
here by Attraction. (vid. Fig. 1st.)

MECHANICAL COMBINATION is of
two kinds,

A

B

1st **MIX-**

1st, MIXTURE; when the Particles of one of the Bodies attract one another stronger, than they do those of the other; in this Case they be both Fluid, the one which is least in Quantity, is broke down into Spheres; Exam- ple, as Oil is when mixed with Water. (Vid. Fig. 2.)

2d, DIFFUSION; when the Particles of the one Body, attract those of the other, as strongly, as they do one another, in this Case they intermix together Equally; Example, as Solution of Blue Vitriol mixes uniformly with Water. (Vid. Fig. 3.) or in the same Manner as Serum and Water.

3d, MECHANICAL COMBINATION, In the Properties of the Elements remain exactly the same as be- fore the Mixture, and the Properties of the Compound depend on them.

When of different specific Gravity, they re- main mixed from Friction, and the Attraction of the Particles of the One, to the largest Quan- tity to one another. (Vide Fig. 4.)

In CHEMICAL COMBINATION the Substances unite by an Attraction, which takes Place between themselves, without any exter- nal Power.

A Particle of each Element unite together, so as to form but one Particle considered Mechanically. (Vid. Fig. 5.) *Example.*

Nitrous Acid, } Form Nitrate, which is to
and } be considered Mechanically, as one simple Substance.
Fixt Vegetable Alkali. }

The Properties of the Compound do not depend on the Properties of the Elements.

No Mechanical Power can separate the Substances so combined.

A Compound may become an Element. (V. Fig. 6.)

When two Substances are to be combined Chemically, we call one of them the *Mentrum*, the other the *Solvent*.

A Mentrum (or Dissolvent) will only combine with a certain Proportion of a Solvent. *Example.* Water will only dissolve a certain Quantity of Salt, and no more.

During the Combination Heat or Cold are often produced. (*Examples.* Vitriolic Acid in uniting with Water, and quick Lime in uniting with Water,) generate Heat. (Sal Ammoniac and Water, Air and Water) generate Cold.

A Menstruum will sometimes dissolve several Solvents at a Time, sometimes only one, as Water will dissolve several neutral Salts at once, but an Acid will only dissolve one Metal at a Time.

The Elements remain combined from the Attraction which takes Place between them.

Two Solids mechanically mixed may be separated.

1st. By **FLUTATION**, that is separating two Bodies in Powder with Water. If one of the two is of greater specific Gravity, or if the Particles of the One, are finer than those of the Other, and both insoluble in Water; if they be mixed with Water, the heaviest, or that whose Particles are largest, will subside first, and the Water may be poured off while the other is still swimming in it. *Example*, Clay and Sand may be separated in this Way; the Clay being finer than the Sand, will remain longer suspended, and therefore may be poured off with the Water.

2^d. By **DISSOLVING** one of them in a Menstruum, in which the other is insoluble; *Example*,

An Acid dissolves calcareous Earth, but not Sand, therefore these two Substances may be separated by pouring upon them an Acid, which dissolving the calcareous Earth, will leave the Sand.

3d, By FILTRATION; if the Particles of the One, are finer than those of the other, by putting them with Water into a Filter, whose Pores will let the Particles of the One pass through with the Water, the other will remain behind. Example, if Sand and Clay be mixed with Water, and poured into a proper Filter, the Clay will pass thro' the Water and leave the Sand.

4th, By EVAPORATION, which is the converting a Body into Vapour and dissipating it. If therefore a fixt and volatile Substance be mixed, we may separate them by evaporating the volatile One.

SOLIDS are Substances whose Particles have their Attraction of Cohesion, stronger, than the Attraction of Gravitation.

FLUIDS have their Attraction of Gravitation stronger, than their Attraction of Cohesion.

10 VAPOURS have their Particles expelled to a considerable Distance, by a Power, easily separated by an external Pressure, or by heat.

HEAT converts Solids into Fluids, and Fluids into Vapour.

Both these Changes generate Cold.

Evaporation is in Proportion to the Surface for external Pressure prevents it from taking Place so readily; and there is the least Pressure on the Surface. (Vid. Fig. 8.)

A Fluid Mechanically mixed with a Solid may be separated;

1st, By FILTRATION; (i. e.) making the Fluid pass through a Filter, whose Pores will not let the Solid pass through.

2d, By SUBSIDING, (i. e.) If they are of different specific Gravity, letting them stand together till the solid has fallen to the Bottom, or risen to the Top.

This Separation takes Place more or less readily, according to the Difference of specific Gravity, the Size or Number of the Particles of the Solid.

3d By

3d, By **EVAPORATION**, which may be performed when One is more volatile than the Other.

Two Fluids may be separated from one another in the same Manner, *viz.*

1st, By **Filtration**, when one is more viscid than the other;

2d, By **Subsiding**, when one is of greater specific Gravity than the other.

3d, By **Evaporation**; when they are volatile at different Degrees of Heat.

Two Substances Chemically combined may be separated;

1st, By **ELECTIVE ATTRACTION**, (i. e.) the Application of a third Substance, which will unite with one, and separate the other from it.

If calcareous Earth be united with an Acid, and fixt Alkali be applied, the Alkali will unite with the Acid and separate the Earth.

This can only happen when a Menstruum dissolves one of two Solvents at a Time, the one uniting with it, repels the other, and is said to attract the Menstruum stronger.

Two Solvents may attract a Menstruum equally strongly, as an Acid attracts fixt Vegetable and fixt Fossile Alkali, equally strongly.

In the following Tables of ELECTIVE ATTRACTIONS, the Menstruum is placed at the Top of the Column, and the Substances it will combine with, are placed under, in such Order, that if any one of them be combined with the Menstruum, any other that stands above it, will separate it; as for Example, if Silver be combined with an Acid, Mercury, Copper, an Alkali, or any other Substance standing above it, will separate it.

Table
If calcareous Earth be united with an Acid, and fixt Alkali be applied, the Alkali will unite with one, and separate the other from it. The Application of a third Substance, which will

This can only happen when a Menstruum dissolves one of two Solvents at a Time, the one uniting with it, repels the other, and is said to attract the Menstruum stronger.

(91)

Table of ELECTIVE Attractions.

ALKALIS & ACID

Phlogiston,

Volatile Acid

Fixt Alkali's,

Caustic Calcareous Earth,

Caustic Volatile Alkali,

Acid of Amber

Magnesia,

Zinc,

Iron, Lead, Tin,

Acid of Bismuth

Bismuth, Antimony,

Copper,

Regulus of Arsenic, Earth of Alum,

Acid of Borax

Mercury,

Silver,

Gold.

Oil

C

Table

Table of ELECTIVE Attractions.

ALKALI'S, & ABSORBENT EARTHS.

Vitriolic Acid,

Nitrous Acid,

Acid of Amber,

Muriatic Acid,

Acetous Acid,

Volatile Vitriolic Acid, Tartar,

Acid of Borax,

Air,

Gold.

Oils.

Table

C

Table

Table of ELECTIVE Attractions.

When one of which is fixed, the other is volatile, by Heat we may often destroy the Attraction between them, and separate the Volatile from the fixed. **MA E V T A L S** Table

Vinegar and Copper be combined in a common Retort, if that vessel be exposed to a sufficient Heat, the Acid driven off, and the Copper left.

Muriatic Acid,

R I A

The Volatile is driven off by Heat, and the Acid driven into Vapour, until we have applied a sufficient Degree of Heat to destroy the Attraction, though it be Volatile water, or any other, in a much smaller Degree.

Vitriolic Acid,

Nitrous Acid,

If a Compound consist of Elements, which are also compounded, they may be decomposed by the same Heat, and the Elements may also unite together.

Acetous Acid,

Alkal's

which was originally in the Compound exposed to the Action of the Fire, as for Example, if we distil Gum Arabic with a certain Quantity of Water, there will come over a Spirit, which will not exist in the Gum.

Air.

« 12 »

Table of Elective Attractions.

ALKALIS, & ABSORBENT EARTHS.

Table of ELECTIVE Attractions.

Vitolic Acid.

Muratic Acid.

A I R.

Vitolic Acid.

Muratic Acid.

Calcareous Earth,

Acetic Acid.

Alkali's.

Air.

2d, By

Table

2 C

Table

2d By HEAT. If two Substances are combined, one of which is fixed, the other Volatile, by Heat we may often destroy the Attraction between them, and separate the Volatile one, by converting it into Vapour. If the Acid of Vinegar and Copper be combined so as to form Verdigrease, if that Verdigrease be exposed to a sufficient Heat, the Attraction will be destroyed, the Acid driven off, and the Copper left.

The Volatile Element cannot be converted into Vapour, until we have applied a sufficient Degree of Heat to destroy the Attraction, although it be Volatile *when separate*, in a much smaller Degree.

If a Compound consist of Elements, which are also compounded, these Elements may be decomposed by the Heat, and their Elements may also unite together, so as to form a Substance, which was not originally in the Compound exposed to the Action of the Fire; as for Example, if we distill Gum Arabic with a considerable Heat, there will come over an Oil, which did not exist in the Gum.

3d, By **COLD**; for Menstruums often dissolve a larger Proportion of Solvends in Heat than in Cold; if therefore a Menstruum is saturated with a Solvend in Heat, upon cooling, Part of the Solvend will be separated; as if boiling Water be saturated with Nitre, upon cooling, Part of the Nitre will separate.

SUBSTANCES may act upon one another Chemically.

1st, By **SOLUTION**; when two Substances combine together.

2d, By **PRECIPITATION**; when a Solvend unites with a Menstruum, and separates another from it; or when upon applying two or more Compounds, the Solvends of the One, unite with the Menstruums of the other.

By **Precipitation** we do not mean the subsiding, but the Chemical Separation.

Substances separated Chemically, require afterwards to be separated Mechanically, by the Means already shewn.

3d, By **FERMENTATION**, (i. e.) a Change of the Properties of a Compound; without any Addition to, or Separation from, the whole Mass, but

but by a new Arrangement of the Elements. Or when a Compound consists of Elements which are also compounded; these Elements decompose one another, and form new ones, which reunite, and produce a Compound, having different Properties from the One, subjected to the Operation.

SUBSTANCES in order to act Chemically upon one another, must almost always be Fluid, or in the State of Vapour.

CHRYSTALLIZATION is a Disposition in Bodies when they become solid, to form themselves into particular Shapes, and to run in certain Directions.

This Power is capable of overcoming very great Resistances. Hence Water in freezing often breaks the Vessel in which it is contained.

Salts in Crytallizing often take up Water in their Crytals.

Part

PART II

The PROPERTIES of BODIES necessary to be known in AGRICULTURE.

1st. Of *SALTS*.

S*ALTS* are Substances which will dissolve in Water, and will not burn; Tartar and its Compounds are Exceptions, as they will burn altho' they be Salts.

Volatile Alkali and its Compounds are Exceptions, in as far as they deflagrate with Nitre.

SALTS are,

- 1st, *SIMPLE* or *ELEMENTARY*, such as cannot be divided into more simple Substances.
- 2^d, *COMPOUND*, such as consist of other Substances more simple.

Elementary Salts are,

1st, *ACIDS*; such *Elementary Salts* as unite with Alkalis into neutral Salts.

2^d, *ALKALIS*; such *Elementary Salts* as unite with Acids, forming neutral Salts.

Com-

Compound Salts are,

1st, Neutral Compounds of Acids and Alkali's.
Example,

Sea Salts consists of { Muriatic Acid,
Fixt Fossili Alkali.

2^d, Metallic Compounds of Acids and Metals. **Example.**

Green Vitriol consists of { Vitriolic Acid,
Iron.

3^d, Earthly Compounds of Acids and Earths.
Example,

Selenites consists of { Vitriolic Acid.
Calcareous Earth.

D

SALTS

Compound Salts are

1st Neutral Compounds of Acids and Alkali's

Example,

Salt consists of { Muriatic Acid
{ Potash Alkali

2^d Metallic Compounds of Acids and Met-

als. Example, S. for

Green Vitriol consists of { Vitriolic Acid

3^d Earthy Compounds of Acids and Earths.

Example,

Selenites consists of { Vitriolic Acid
{ Calcareous Earth

Salts

Salts are formed by the union of acids with earths or alkalis. They are not bodies in themselves, but are formed by the union of two or more simple substances.

Elementary Salts are

SALTS

1st Acid Salts, formed by the union of acids with alkalis.

2^d Alkali Salts, formed by the union of alkalis with acids.

Comp.

S A L T S found in SOILS are,

NAMES.

VITRIOLIC ACID,

Synonima,

Oil of Vitriol,

Spirit of Vitriol,

Oil of Sulphur,

Spirit of Sulphur,

Universal Acid,

Fossile Acid.

The Manner in which they are found or produced.

It is found in the Earth in Sulphur. Sulphur consisting of Vitriolic Acid, and inflammable Matter; exposed to the Air, is decomposed, the inflammable Matter flying off, leaves the Acid behind; if therefore there be Sulphur, or any of its Compounds in the Soil, Vitriolic Acid, or some of its Compounds will be produced.

It is produced in the burning of all inflammable Substances, when reduced to a Charcoal.

It is the only Acid found in the Air, excepting near the Sea, and where there are large Masses of putrifying Substances, and it may be attracted from the Air by Alkali's or Earths.

Their PROPERTIES.

It unites with

1st, Fixt vegetable Alkali, forming vitriolated Tatar.

2d, Fixt Fossile Alkali, forming true Glauber's Salts.

3d, Iron, forming Green Vitriol.

4th, Copper, forming blue Vitriol.

5th, Zinc, forming white Vitriol.

6th, Calcareous Earth, forming Selenites.

7th, Magnesia, forming Magnesia Glauber's Salts.

8th, Clay, or Earth of Alum, forming Alum.

It attracts Alkali's and Earths, stronger than any other Acid.

S A L T S found in S o i l s are,

N A M E S.	The Manner in which they are found or produced.	Their P R O P E R T I E S.
NITROUS ACID.	It is always produced by the last Stage of Putrefaction, and is found either in the putrid Mass, combined with Calcareous Earth, or Volatile Alkali, or in the Air near it.	It unites with 1st, Fixt Vegetable Alkali, forming Nitre 2d, Volatile Alkali, forming Nitrous Ammoniac. 3d, Calcareous Earth. 4th, Magnesia. Its Compounds deflagrate with any inflammable Substance, (i. e.) the inflammable Matter unites with the Acid, and precipitates the Alkali; at the same Time there is a great Separation of Air, and a considerable Degree of Heat produced.
Synonima,		
<i>Spirit of Nitre,</i>		
<i>Glauber's Spirit of Nitre,</i>		
<i>Aqua Fortis.</i>		

SALTS

S A L T S found in S o i l s are,

NAMES.

MURIATIC ACID.

Synonima,

*Spirit of Salt,**Glauber's Spirit
of Salt,**Marine Acid.*The Manner in which they are
produced.It is found in the Earth, in Mineral Waters,
and in the Sea, combined with the fixt Fossile
Alkali, Calcareous Earth, Magnesia, or Earth
of Alum.It is formed by the Putrefaction of Animal,
or Vegetable Substances, and is found in the
putrid Mass, combined with Calcareous Earth
and volatile Alkali.It is found in Soot, combined with Volatile
Alkali.

It is found in the Air near the Sea.

Their PROPERTIES.

It unites with
1st, Fixt Fossile Alkali, forming Sea
Salt.2d, Volatile Alkali, forming common
Sal. Ammoniac.

3d, Iron.

4th, Copper.

5th, Zinc.

6th, Calcareous Earth, forming fixt
Ammoniac.

7th, Magnesia.

8th, Earth of Alum.

It attracts Metals stronger than any other
Acid.

SALTS

S A L T S found in S O I L S are,

N A M E S.	The Manner in which they are produced.	Their P R O P E R T I E S.
FIXT. VEGETABLE ALKALI,	It is formed in the Burning of Vegetable Substances, and is found in their Ashes.	It is either free from Air, when it is called Caustic; or Combined with Air, when it is called Mild.
<i>Synonima,</i> Combined with Air	It is not an Element of the Vegetable, but is produced from its Elements by the Operation.	In both Cases it unites with 1st, Vitriolic Acid, forming Vitriolated Tartar.
Salt of Tartar,	It is not found in the Ashes of Sugar, or in those of any putrid Vegetable.	2d, Nitrous Acid, forming Common Nitre.
Salt of Wormwood,		3d, Muriatic Acid, forming Digestive Salt of Sylvius.
Pot-ash,		It attracts Water from the Air.
Pearl-ash,		When Caustic, it dissolves 1st, Oil, forming Soap. 2d, Animal and Vegetable Substances, forming a Soap.
Fixt Nitre:		Both Mild and Caustic, it attracts Acids stronger than Volatile Alkali, Metals, or Earths.
When free from Air		
Caustic fixt Vol. Alkali,		
Common Caustic,		
Soap Leys,		

SALTS found in SOILS are,

NAMES	The Manner in which they are found or produced.	Their PROPERTIES.
Fixt Fossil Alkali	It is found in the Earth and Mineral Waters.	It is either free from Air when it is called Caustic, or combined with Air when it is said to be mild.
Synonyma, Combined with Air	Sometimes pure, sometimes combined with Vitriolic, Murtriac, or Boracic Acids, or with Sulphur.	In both Cases it unites with
Natron, Jew Nitrum Plinii	Upon burning any Vegetable containing Sea Salt, it is found in the Ashes.	1 st , Vitriolic Acid, forming Glauber's Salts.
Soda,		2 ^d , Murtriac Acid, forming common or Sea Salt.
Sal Soda,		It dries in the Air.
Barilla,		It separates Volatile Alkali, Earths and Mettals from Acids.
Kelp.		When Caustic it dissolves
When free from Air		1 st , Oils, forming Castile Soap,
Soap Dye,		2 ^d , Animal and Vegetable Substances, forming a Soap.
Caustic Fixt Fossile Alkali.		

SALTS

SALTS found in SILLS are,

NAMES. The Manner in which they are found or produced. Their PROPERTIES.

VOLATILE ALKALI Synonyma,	It is found in the Juices of Animals, combined with Muriatic, and phosphoric Acids.	It is either free from Air, when it is called Caustic, or combined with Air when it is said to be Mild.
When dry and mild Volatile Salt of Sal Ammoniac.	It is found in Soot, combined with Muriatic Acids.	In both Cases it unites with
Salt of Hartshorn, Bones, Blood, or any other ani- mal Substance.	It is found in the last Stage of Putrefaction, and is found in the putrid Mass, combined with Nitrous, or Muriatic Acids.	1st, Nitrous Acid, forming Nitrous Ammoniac.
When dissolved in Water and mild Spt. of Sal Ammoniac, Spirit of Hartshorn, &c.	It is never found in Soils uncombined, on Account of it's Volatility.	2d, Muriatic Acid, forming common Sal. Ammoniac.
When dissolved in Water & Caustic Spirit of Sal Am- moniac with Quick Lime.		3d, Phosphoric Acid.
		When Caustic it precipitates Magnesia, Earth of Allum, and all the Metals from any Acid, but not Calcareous Earth.
		When Mild it also precipitates Calcareous Earth.

SALTS found in SOILS are,

COMPOUND SALTS are Combinations of any Elementary Salts, with any other Body, when that Compound has the Properties of a Salt.

NEUTRAL SALTS; or Compounds of Acids and Alkalis found in Soils, are,

NAMES The Manner in which they are found or produced. Their **PROPERTIES**

VITRIOLATED It is contained in the Ashes of all Vegetables,

TARTAR, and is formed on applying fixt Vegetable Al-

Its Elements, Kali to a Soil, by precipitating a Metal, or

Vitriolic Acid, Earth, from the Vitriolic Acid, if any Metally

Fixt Vegetable or Earthy Salt be contained in the Soil; or by

Alkali, attracting the Vitriolic Acid from the Air:

GLAUBERS SALT, It is found native in Mineral Waters.

Its Elements, It is produced by the Burning of a Vegetable

Vitriolic Acid, containing Sea Salt, and is found in its Ashes.

Fixt Fossile Alkali.

It is difficultly solubile in Water, requires a great Quantity of Water to dissolve it, and remains dry in the Air.

It dissolves easily in a small Proportion of Water, and dries in the Air.

SALTS

SALTS found in SOILS are,

NAMES.	The Manner in which they are found or produced.	Their PROPERTIES.
NITRE. <i>Synonima,</i> <i>Salt Peter,</i>	It is formed by applying fixt Vegetable Alkali in a Soil, by precipitating Volatile Alkali, Calcareous Earth, or Magnesia, from the Nitrous Acid.	It remains dry in the Air, and deflagrates with any Inflammable Matter.
<i>Elements,</i> { Nitrous Acid, { Fixt Veget. Alkali,	It is formed by applying fixt Fossile Alkali to a Soil, as common Nitre.	Properties the Same as Common Nitre.
<i>Elements,</i> { Nitrous Acid, { Fixt Fossile Alkali.	It is produced by the last Stage of Putrefaction.	It attracts Water from the Air, it deflagrates with any Inflammable Matter, or upon being heated red hot.
NITROUS AMMONIAC. <i>Elements,</i> { Nitrous Acid, { Volatile Alkali.		

NEUTRAL SALTS found in SOILS are,

NAMES.	The Manner in which they are found or produced.	Their PROPERTIES.
DIGESTIVE SALT of SYLVIVS. <i>Elements,</i> { <i>Muriatic Acid,</i> { <i>Fixt Veget. Alkali.</i>	It is formed by applying fixt Vegetable Alkali to a Soil, containing any Ammonical, Earthy, or Metallic Salt, with the Muriatic Acid; the fixt Alkali, separating the Volatile Alkali, Earth, or Metal, from the Acid.	It remains dry in the Air.
COMMON SALT. <i>Synonima,</i> <i>Common Sea Salt,</i> Which is impure, containing Salts with Magnesia. <i>Bay Salt,</i> <i>Sal Gem,</i>	It is found Naturally in the Earth, and in almost all Spring Waters; hence almost every Soil contains it.	It remains dry in the Air.
<i>Elements,</i> { <i>Muriatic Acid,</i> { <i>Fixt Fossile Alkali.</i>	It is formed by Putrefaction, and is also found in Soot.	It remains dry in a dry Air.
COMMON SAL AMMONIAC. <i>Elements,</i> { <i>Muriatic Acid,</i> { <i>Volatile Alkali.</i>		

G

SALTS

SALTS found in Soils are,

METALLICK SALTS, or Compounds of Acids and Metals.

NAMES.	The Manner in which they are found or produced.	Their PROPERTIES.
GREEN VITRIOL. <i>Elements</i> { <i>Vitriolic Acid,</i> <i>Iron.</i>	It is formed by the Decomposition of Pyrites, or is found in Mineral Waters.	It coagulates Vegetable Juices, and hardens their Solids.
MURIA FERRI. <i>Elements,</i> { <i>Muriatic Acid,</i> <i>Iron.</i>	It is found in Mineral Waters.	It coagulates Vegetable Juices, and hardens their Solids.

EARTHY SALTS, or Compounds of Acids and Earths, are

SELENITES. <i>Synonyma,</i> <i>Gypsum,</i> <i>Paris Plaster.</i> <i>Elements,</i> { <i>Vitriolic Acid,</i> <i>Calcareous Earth.</i>	It is found Native. It is formed by Exposure of Calcareous Earth to the Air, from which it attracts Vitriolic Acid, and is also formed by the Precipitation of Magnesia, Earth of Alum, or Metals from Vitriolic Acid by Calcareous Earth.	It requires a very large Proportion of Water to dissolve it, is with difficulty soluble in Water, and remains dry in the Air.
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EARTHY

EARTHY SALTs found in Soils are,

NAMES.

The Manner in which they are found or produced.

Their PROPERTIES.

NITROUS SELENITES.

It is formed by Putrefaction.

It deflagrates, and attracts Water from the Air.

Elements,

{ *Nitrous Acid,*
 { *Calcareous Earth.*

LIQUID SHELL.

Synonima,

It is found Native, and formed by Putrefaction.

It attracts Water from the Air.

Fixt Ammoniac,

Elements,

{ *Muriatic Acid,*
 { *Calcareous Earth.*

EARTHY

EARTH Y SALTS found in Y S L S Are,

NAMES, The Manner in which they are found or produced. Their PROPERTIES.

MAGNESIA
GLAUBER'S
SALTS.

Synonyma,

*Epsom Salt, & the
purging Salt of
most Mineral Wa-
ters.*

Elements,

{ *Vitriolic Acid,*
{ *Magnesia.*

MOTHER OF NITRE

Elements,

{ *Nitrous Acid,*
{ *Magnesia.*

EARTH Y

It is found Native in Soils, and very frequently in Spring Waters, and it is produced by the Exposure of a Solution of any Neutral Salt, containing Vitriolic Acid, in a large Proportion of Water, to the Air.

It is produced, by the Exposure of a Solution of any Neutral Salt, (containing Nitrous Acid) in a large Proportion of Water, to the Air.

It attracts Water from the Air.

It deflagrates with any Inflammable Substance, and attracts Water from the Air.

SALTS

S A L T S found in S O I L S are,

N A M E S.	The Manner in which they are found or produced.	Their P R O P E R T I E S.
M U R I A M A G - N E S I A , Elements, { Muriatic Acid, { Magnesia.	It is found Native, and is produced, by the Exposure of a Solution of any Neutral Salt, (containing Muriatic Acid) in a large Proportion of Water, to the Air.	It attracts Water from the Air.
COMMON ALLUM.	It is found Native, and formed by the Exposure of Clay, containing Pyrites, to the Air.	It remains dry in the Air.

A L L these S A L T S prevent Putrefaction, excepting those in which Calcareous Earth, or Magnesia, is one Element; these on the other Hand forward it.

All COMPOUND S A L T S, dissolved in Water, (so that the Solution shall contain a very large Quantity of Water, in Proportion to the Salt,) and exposed to the Air, are decomposed; *Viz.* in the *Neutral Salts* the Alkali is converted into Magnesia, with which the Acid combines, and forms an Earthy Salt. In the *Earthy and Metallick Salts*, the Acid flies off into the Air, and the Earth, or Metal subsides, leaving the Water pure; hence River Water, &c. are purer than Spring Water.

This Decomposition is greatly forwarded by Heat.

The *Metallick Salts* are decomposed in this Manner the most readily; next to these the *Earthy*; and the *Neutral* are the slowest in their Decomposition.

All these Salts, except the Alkali's, tend to harden Animal and Vegetable Solids, and coagulate their Juices; the Metallick Salts and Allum most powerfully; next to these the Acids; after them, the other Earthy Salts, and the Neutral Salts are least apt to have this Effect.

E A R T H Y

H

N I

INFLAMMABLE Substances found in SOILS.

NAMES.

SULPHUR.

*Synonima,**Brimstone,**Elements**Vitriolic Acid,**Phlogiston, (i. e.**Pure Inflam-
ble Matter.)*The Manner in which they are found or
produced..It is found Native in the Earth pure; or combined with Metals, particularly Iron, Copper, or Arsenic, forming PYRITES; or combined with Calcareous Earth, or Fossile Alkali forming *Hepar Sulphuris* in foetid Mineral Waters.It is found in the Ashes of Vegetables, when they are not burnt white, combined with fixt Alkali, forming *Hepar Sulphuris*.

Their PROPERTIES.

It decomposes upon being moistened and exposed to the Air in its pure State, and also when combined with any of these Substances, the Phlogiston flying off into the Air, and leaving the Acid, which unites with any Metal, or absorbent Earth there may be in the Soil, or with the Clay.

It is insoluble in Water.

OIL, as a Fluid not soluble in Water, would get into the Ends of the Vessels of Plants, shut up their Pores, and prevent the Absorption of the Water.

EARTHY

E A R T H S found in S O I L S are,

N A M E S.	The Manner in which they are found or produced.	Their P R O P E R T I E S.
CHRYSTALLINE. Synonima, <i>Flint,</i> <i>Sand,</i> <i>Gravel,</i> <i>Granitt,</i> <i>Quartz,</i> <i>Precious Stones.</i>	It is found Native, always in Chrystals, (whole or broke down,) or in Masses formed from Chrystals.	It is always hard enough to strike Fire with Steel. It is perfectly insoluble in Water and Acids. Its Powder moistened with Water, has no Tenacity, nor does it harden when dried or heated by the Fire.
ASBESTIS, TALC, and FUSIBLE SPAR. C-L-A-Y.	It is found Native. It is found Native.	Excepting that they are softer, and more friable, they agree with Chrystalline Earth in Properties. It is soft and in fine Powder. If it be mixed with Water, it forms a tenacious Mass, which hardens upon drying, and does not diffuse so readily in Water again as Sand.
		If a Mass of it be heated red hot, it becomes hard, and burns into a Brick, and resembles in its Properties Chrystalline Earth.
		Soap Earth agrees in its Properties with Clay, of which it is a Species, only it is much more diffusible in Water, separates from it with greater Difficulty, is of a smoother Texture, and finer Particles.
		By Culture, Clay becomes more diffusible in Water. It unites with Acids with great Difficulty. Combined with Vitriolic Acid it forms Allum. It is insoluble in Water.

The Earth consists principally of Strata of these Substances, in which the Clay, & Chrystalline Earth are sometimes found pure, but more commonly there is a Mixture of the two, and we seldom find pure Clay, than pure Sand.

The other Earths are EXTRANEOUS.

ABSORBENT EARTHS found in SOILS are,

NAMES

**CALCAREOUS
EARTH.**

Synonima,

When combined with
Air.

Animal Earth,

Marble,

Limestone,

Chalk,

Marle.

When free from Air.

Quick Lime.

The Manner in which they are found
or produced.

It would appear that the greatest Part of the Earth is produced from the Exuviae of Animals, particularly the Shells of Fishes.

It is also produced by burning Animal or Vegetable Substances; and by the last Stage of Putrefaction.

The Earth, so produced, did not subsist in the Animal or Vegetable, (except in the Bones,) but is form'd by Putrefaction.

Their PROPERTIES.

It may be had combined with Air when it is called *Mild*, or free from Air when it is said to be *Cautic*,

In both these Cases it unites with,

1st, Vitriolic Acid, forming Selenites.

2d, Nitrous Acid.

3d, Muriatic Acid, forming fixt Ammoniac.

It will separate any Metal, from any Acid.

Quick Lime or Calcareous Earth free from Air, is formed from Limestone, Chalk, &c. by exposing them to about a red Heat; the Attraction between the Earth and Air is destroyed, and the Air driven off.

If the Calcareous Earth be mixed with any other Substance, which has the Effect of a Flux, a moderate Heat must only be used, as otherwise the Surface of the Limestone would Melt,
I and

ABSORBENT EARTHS found in SOILS are,

NAMES. The Manner in which they
are found or produced.

Their PROPERTIES.

and form a Crust, which would prevent the Evaporation of the Air: this is to be known, by throwing a Piece of the Stone into a Common Fire, and blowing against it with a pair of Bellows, if there be any such Substance, the Surface will Melt.

A White Heat for the above Reason is too great to burn any Limestone with.

Calcareous Earth, produced by the burning of any Animal Substance, cannot be burnt into Lime, except it be first dissolved in an Acid, and separated by an Alkali.

Quick Lime, like dry Neutral Salts, unites with Water, and Chrystallizes, and the Chrystals in Shooting break down the Mass, and separate from one another, so that the whole appears to fall into a fine Powder; and if one Third of the whole consists of Lime, it is sufficient to break down the remaining Part; hence if Limestone contain one third Part of Calcareous Earth, it may be burnt into Lime; or if it consist wholly of Calcareous Earth, and one third Part of it be burnt, it will fall down; and Lime is seldom thoroughly burnt.

ABSORBENT

ABSORBENT EARTHS found in SOILS are,

NAMES. The Manner in which they
are found or produced.

Their PROPERTIES.

If Limestone contains no other absorbent Earth, except Calcareous, the Quantity of that Earth, is known by throwing 100 Grains into an Ounce of Muriatic Acid, diluted with four Ounces of Water, letting the whole stand till there is no more Effervescence, throwing what remains into a Filter; when the Fluid has filtrated thro', pouring upon what remains half a Pint of Water, letting that filter off also, then drying and weighing what is left in the Filter, the Weight lost gives the Proportion of the Calcareous Earth.

If there be any other Absorbent Earth, upon pouring into what filtrated thro' two Ounces of Caustic Volatile Alkali, a Precipitation will take place; this Precipitate is also to be separated by Filtration, and its Weight deducted from the Calcareous Earth.

The Quantity of Lime burnt is known, by putting 100 Grains into a filtrated Solution of two Ounces of Sal Ammoniac in half a Pint of Water, boiling them toge-

ABSORBENT

ABSORBENT EARTHS found in SOILS are,

NAMES | The Manner in which they
are found or produced.

Their PROPERTIES.

ther in a Glass, or Stone Vessel, for an Hour, or untill there is no Smell of Volatile Alkali; taking Care to add Water as the former evaporates; afterwards filtrating what remains; after the Filtration, pouring upon what is in the Filter, half a Pint of Water, letting that filter off also; then drying and weighing what remains in the Filter, the Weight lost is the Lime burnt.

If Calcareous Earth is found in a loose Mass, so as to break down very readily, it is with Difficulty burnt into Lime, as the Fuel can hardly burn if mixed with it; and if it is mixed with Clay, it will burn into a Brick, which will both prevent the Evaporation of the Air, and the falling of the Lime; in both these Cases it is called Marle.

Calcareous Earth when mixt with Clay, gives a greater Friability to it than Sand does; hence Marle falls easily down in Water.

Quick Lime dissolves in Water in the Proportion of about five Grains to a Pint.

ABSORBENT

ABSORBENT EARTH found in S & H are,

NAMES. The Manner in which they are found or produced.

Their PROPERTIES.

It unites with Sulphur, forming *Hepar Sulphuris*.

It unites with Animal and Vegetable Substances, forming a Soap.

It prevents Putrefaction.

It attracts Acids stronger than Volatile Alkali or Magnesia.

If it be exposed to the Air, it attracts from it the fixable Air, and reverts to the State it was in before it was burnt.

Mild Calcareous Earth, forwards Putrefaction.

It is insoluble in Water.

When Calcareous Earth is reduced to a Powder, and applied to a Soil, it is apt to be washed thro' it.

Caustic Volatile Alkali will not precipitate Calcareous Earth, if dissolved in an Acid; but fixt Vegetable Alkali will; this distinguishes it from the other Earths.

Vitriolic Acid will not dissolve it so as to form a clear Solution; and if this Acid be added to a Solution of it in any other, it will make a Precipitation.

ABSORBENT

ABSORBENT EARTHS found in SOILS are,

THE MANNER in which they are found or produced. Their PROPERTIES.

MAGNESIA. It is produced by the Decomposition of any Salt containing Magnesia, by Exposure to the Air, or applying to it an Alkali, or Caustic Calcareous Earth.

It may be had combined with Air or free from Air.
In both Cases it unites with
1st, Vitriolic Acid, forming Magnesia Glauber's Salts.
2^d, Nitrous Acid.
3^d, Muriatic Acid.
It is insoluble in Water.
It assists Putrefaction.

EARTH of ALLUM. It is produced by the Decomposition of Allum.

It may be had free from Air, or combined with Air.
In both Cases it unites with Vitriolic Acid, forming
Allum.

Animal

K

AIR

A B S O R B E N T A I R

AIR is a **VAPOUR** not condensible in the Heat of the Atmosphere without Combination.

AIR is of several Kinds, *Viz.*

NAMES. The Manner in which they are found or produced, and their **PROPERTIES.**

RESPIRABLE AIR, That which serves for the Life of Animals and Vegetables, and Inflammation of Fuel.

FIXABLE AIR. That which is contained in Alkalis, and Absorbent Earths when they are Mild. It will neither serve for the Respiration of Animals, nor Vegetables, nor the Inflammation of Fuel, but it is not poisonous.

INFLAMMABLE AIR. Separates from Metals while they combine with Acids, is often found in the Earth near Mines, and is poisonous.

There are also several other Kinds of Air.

Animal

Animal and Vegetable SUBSTANCES found in Soils are,

NAMES. The Manner in which they are found or produced.

Their PROPERTIES.

ANIMAL FIBRES.

Dissolved in Water, form a Solution, which Jellies.

VEGETABLE FIBRES.

They form when dissolved in Water, a Solution which is Gummy.

VEGETABLE & ANIMAL MUCILAGENOUS JUICES.

They form a Gummy Solution in Water, but if putrified, a Gelatinous one.

BITTER, ASTRINGENT, RESINOUS &c. JUICES of VEGETABLES.

They prevent Putrefaction.

Animal

Animal and Vegetable SUBSTANCES found in SOILS are,

NAMES.

The Manner in which they are found or produced.

Their PROPERTIES.

MUCILAGE.

It is produced by the Putrefaction of Animal or Vegetable Substances, and is applied to Soils in

Gives Viscidity to a large Proportion of Water. M A M

1st, The Dung of Animals.

2d, Putrid Animal or Vegetable Fibres, or Juices.

3d, The Roots of Plants, if they putrify in the Soil.

4th, The Exudation from the Roots of the Plants, growing in the Soils, if it putrifies.

It prevents the Evaporation of Water.

5th, The Insects in Soils, if they putrify.

6th, The Dung of the Insects.

It gives Tenacity to Sand, and Friability to Clay.

7th, The Animal and Vegetable Substances contained in Rain Water and Dew, if they putrify.—There are two Stages of Putrefaction, the first produces Mucilage, the second converts it into Calcareous Earth, Muriatic and Nitrous Acids, and Volatile Alkali.—Vegetable Substances, before they putrify, go through the Saccharine, Vinous, and Acetous Fermentations, but Animal Substances putrify immediately.—Two, or more of these Fermentations, may go on in the same Mass, at the same Time; as for Example; What is already converted into Wine, may be converted into Vinegar, while another Portion of the Mass is converting into Wine.—The Saccharine, Vinous, & Acetous Fermentations, generate Heat, but the Putrefactive does not.—In Order that any Substance should be formed by a Fermentation perfectly, it is necessary that the Operation go on neither too fast, nor too slowly.—The Substances forwarding Putrefaction encrease the Quantity of Mucilage, by making Animal or Vegetable Matters putrify, which would either not have putrified at all, or which would have putrified too slowly. But they also tend to destroy it, by making the Mucilage proceed to the second Stage of Putrefaction, and so convert it into Earth and Salts.

It cannot be separated from Water by Filtration.

They tend more to forward the first, than the second Stage of Putrefaction.

PART III.
The Structure and Oeconomy of
VEGETABLES, necessary to be
known in AGRICULTURE.

THE principal Vessels of Plants are of two Kinds, *Tubes and Cells.*

The **TUBES** run from the Roots to the different Parts of the Plant in separate Bundles, communicating with one another, but not joining and branching as in Animals.

These Tubes contain principally the Mucilaginous, and Saccharine Juices, serving for the Nourishment of the Vegetable.

The Tubes being capillary, if empty and immersed in Water or any other Fluid, have a Power of filling themselves by the Attraction of their Sides to the Fluid; but this will not by any Means account for the Circulation in Vegetables; there is therefore a Power similar to the Muscular Power in Animals, by which this Motion, (at least in Part) and all the other Motions of Vegetables are performed.

The

The CELLS contain the peculiar Juices of Plants, and most probably these are formed in them by Fermentation: They communicate with the Tubes, or rather the Tubes terminate in them.

In the ROOT of a Plant the Cells surround the Tubes, which are only open at the extreme Points of the Fibres, and Fluids cannot be absorbed by them any where else.

The Tubes are not simply open at the End of the Fibres, but there is a particular Configuration, which adapts them to absorb Fluids, so that if the Ends of all the Fibres of the Roots of any Vegetable be cut off, the Growth of that Vegetable is stopped, till fresh Fibres are formed.

Unless there be a Number of Fibres in the Root, a Plant will seldom flourish, in as much as a sufficient Quantity of Nourishment cannot be absorbed.

More numerous Fibres may be made to break out by

A sufficient Tenacity in the Soil,

Richness of Soil,

Cutting the Fibres, in which Case they do not go on, but branch out into new ones,

Poisoning the weak Fibres, and

Cutting the Branches,

But

But the Fibres are rendered too weak for the Support of the Plant by Too great a Tenacity of the Soil, Applying Poison in too great a Quantity. And Cutting the Branches too much.

As ROOTS can only absorb Nourishment from the Points of their Fibres, the Cells surrounding them serve to defend the Tubes from Water, which they do, if the Soil be moderately dry; but in very moist Soils the Water soaks through to the Tubes, stops the Circulation in them, and rots them.

The Roots of some Plants will bear a much greater quantity of Moisture than those of others.

In Trees and Shrubs, the Stems which are above a Twelvemonth old, are to be considered as Roots, having the same Structure.

At that Part where the Root is converted into a Stem, the Tubes devaricate; and are placed on the Out-side; being covered only with a thin Bark, which is of the same Texture, and answers the Purposes of the Leaves, the Cells forming the Pith, being contained in the Middle.

Water constantly evaporates from the Leaves

and the Bark of the Stem, and carries along with it, the Volatile Parts of the Juices, and some small Portion of the more fixed; but they attract Water from the Atmosphere at the same Time, so as in some Cases to nourish the Plant totally; and the Roots also throw out a Part of the Juices into the Ground.

There is a considerable Difference betwixt that which evaporates into the Air, and that which exudes into the Ground, as the former contains Water with the essential Oil of the Vegetable, and the latter the Mucilaginous Juices.

The Exudation from the Roots takes Place in the greatest Quantity.

1st, While the Leaves are flourishing, hardly any Thing flowing out after they begin to decay.

2d, In Plants that are moderately succulent;

3d, In Perennial Plants, at the Time of the flowing of the Sap.

OF THE GROWTH OF PLANTS.

A SEED consists of

The Husk, a Membrane covering the other Parts.

has

The **Composition** is, **one, two or three**
Masses of Farinaceous Matter

The **EMBRYO**, (i. e.) the young Plant,
consisting of a **Radicle** and **Plumule**.

The **EMBRYO** lies in a dormant State, (i. e.)
alive, but not exerting its Life, until it is put
in proper Circumstances; which are

Heat,
of Moisture, and
Exposure to the Air.

It requires different Degrees of these to make
different Seeds grow.

1st, If a Seed once begins to grow and is
stopt, the Embryo dies.

2d, The Embryo may also die from Age,
(i. e.) if the Seeds are kept too long;
and in some Seeds this happens in 12
Months, in others not in 12 Years.

3d, Or it may be destroyed by Insects;

4th, Or it may undergo Fermentations from
Moisture.

5th, Or it may be killed by Poisons.

In all these Cases the Vegetation of the Seeds
is destroyed.

When

When a Seed is put in the proper Circumstances for growing, the farinaceous Matter in the Cotyledons is converted into Sugar, the Embryo swells, and the Radicle pushes forwards till it gets through the Husk, and afterwards runs perpendicularly downwards, till it breaks out into Fibres.

These Fibres run in different Directions, but never penetrate above a certain Depth from the Air.

The PLUMULE, when the Radicle has got into the Earth, rises upwards, sometimes bringing along with it the Cotyledons, which are in some Cases converted into the Seed Leaves.

During this Time, the Plant is nourished principally by the Cotyledons; for if the Root be destroyed, the Plumule will still rise up, and when it gets above Ground, and its Leaves spread, fresh Roots will be thrown out.

If a Plant be cut off below the Cotyledons, it will hardly ever push out fresh Leaves, but it rots and is destroyed; on the other Hand, if it be cut off above the Cotyledons, it generally shoots afresh, and continues to grow; therefore, if Plants, whose Cotyledons come above Ground,

as Turneps, be cut, or eat to the Ground by any Animal, they decay; but if such whose Cotyledons remain below Ground, (the Grasses for Example) are cut, they will shoot out afresh.

After the Plumule is come above Ground, in the Grasses, there is a Knot or Swelling form'd above the Cotyledons, where the Stem divides into, or throws off, several Branches, and fresh Roots; and as soon as the Leaves of these spread the first Root dies. This is called *Tillering*.

These Branches are more or less numerous, according to

The richness of the Soil;

The Tenacity of it;

The Room the Plant has to grow in;

The Moisture of the Soil; and

The Earlynefs of the Season.

Each of these Branches may be made to divide a second Time;

By sowing the Seed early in the Autumn;

it in this Case branching out in the

Autumn, and again in the Spring;

By cutting the Stem;

By cutting the Roots;

By Transplantation;

By

By great Moisture in the Soil, hence Corn after it has flowered, will sometimes branch out a second Time, after heavy Rains.

If a Grass be made to branch out a second Time, in a poor Soil, or a dry Season, the Branches are apt to run up weak.

Most Perennial Plants, (excepting Trees and Shrubs,) become so by branching out afresh every Autumn; the old Roots and Plants dying.

ROOTS push forward with considerable Force, which however is not equal in all Plants, and a sufficient Resistance stops them, and makes them branch out laterally.

If the Resistance from the Tenacity of the Soil be too great, they break out into a vast Number of Branches, too weak to support the Plant, and if too little, they run out into long Fibres, having too few Ends or Mouths, to absorb sufficient Nourishment.

The ROOT always runs where there is the least Resistance.

The **STEMS** go on flourishing more or less, according to

1st, The Moisture of the Soil;

2d, The Heat;

3d, The Soils being adapted to the Roots;

4th, The Richness of the Soil, and its freedom from noxious Substances;

5th, The Time the Seed has been kept,

Viz. the shorter the Time it has been kept, the more luxuriant the Plant.

The **STEM** pushes out from it the **FLOWER STEM**, which arises either laterally as the Leaves spread, as in Peas, or terminates the Stem, and in this Case either there is only one, as in Grasses, or several, as in Turneps and Cabages.

When the Flower-Stem arises laterally, the Leaves continue to flourish after the Flower is dropt off, and of Consequence until the Seed is perfected, and the whole Plant dies; but when the Flower-Stem is terminal, the Leaves begin to wither, as soon as the Flower drops off. Hence, as the Nourishment is taken entirely from the Ground, without any Exsudation of any Thing imbibed from the Air into it, after this Period, Grasses and other Plants having

ing terminal Flowers, enrich the Soil till they flower, but afterwards impoverish it, perhaps in some Degree in Proportion to the Weight of the Seed.

In Grasses new Leaves spring out from the Stem after the flowering, and those which have already sprung out, begin to loose their Juices, and decay.

GRASS should therefore be cut for Hay, as soon as it is fully in Flower. Different Grasses flower sooner, or later, therefore if two Grasses grow on the same Field, either one or other must be cut too soon, or too late.

All Plants have Male and Female Parts of Generation; the *Chives* or Male Part, the *Pointal* or Female Part.

The CHIVES are Bags, containing a Powder, they open just as the Flower opens, and the Powder impregnates the Female Part.

This Impregnation is prevented,

- 1st, By Cold;
- 2d, By very violent Rains;
- 3d, By Weakness of the whole Plant;
- 4th, By Weakness of the Roots; so that in moist Soils, or very rainy Seasons, when the Plant appears to be flourishing greatly

greatly, and a sufficient Quantity of Flowers are thrown out, the Impregnation does not take Place, and the Seed, or Fruit, either drops off entirely, or is small and shrivelled, the Roots being rotted by the Moisture.

5th, By the Want of Air.

When the Leaves and Stem of a Plant flourish greatly, it seldom produces many Flowers.

In Grasses, as the Nourishment is drawn from the Roots after they Flower, if the Roots are rotted by Moisture, the Seeds will not be perfected: In the ripening of the Seed, the Farinaceous Part of the Cotyledon is produced.

Plants cannot live without AIR; it answers probably the same Purposes to them that it does to Animals.

The Action of the Air appears to be principally on the smooth Surface of the Leaves, or the Bark of the Stem.

The Air is rendered effete by the Plant, so that there must be a continual supply of fresh Air, otherwise the Stem runs out to a great length, is exceedingly small and weak, the

Leaves endeavour to spread out to a great Distance, no Impregnation takes place in the Flowers, the proper Juices are not formed, and the whole Plant is destroyed.

Hence, if several Plants are sown in a Soil, those which are best adapted to it will grow up strongest, rob the others of the Air, and destroy them.

The Roots also require Air, so that if a Root be planted too deep it will not grow, and different Roots require also different Degrees of Exposition.

It is only respirable Air that will answer these Purposes.

LIGHT is also necessary for the Growth of a Plant, but not so much so as Air.

Most Leaves have two Surfaces, one of which is always exposed to the Light, and if the other is turned to it, (by altering the Position of a Branch) the growth is frequently stopt, until the Leaves turn themselves to it again.

This smooth side of the Leaf therefore, being that which is acted upon by the Air, and Light, would

would appear to be that Part by which a Plant principally lives, and in many Plants the Leaves shut themselves up so as to cover this smooth Side on exposure to cold Air, noxious Vapour, Darkness, or even upon being touched.

The want of a sufficient Quantity of Light prevents the Plant from forming its proper Juices, (except Mucilage and Sugar) deprives it of its Blue Colour, (the Green consisting of Blue and Yellow,) leaving it either Yellow or Colour-less, makes it run up weak, and prevents the Impregnation of the Seeds.

Want of a sufficient Quantity of Air and Light, more especially prevent the Impregnation of the Seeds.

HEAT in a moderate Degree, according to the Disposition of the Plant, makes the Leaves flourish, and the Stem strong, provided the Soil is sufficiently moist; in a very great Degree it makes the Plant run up to Seed too soon, especially in a dry Soil, and prevents the growth of the Leaves.

Heat also prevents Moisture from rotting the Roots, or any other Part of a Plant, but it encreases the Effects of most other Poisons.

Plants are subject to HABITS, the principal of which are;

1st, The Seed's growing early in the Spring, and the Stems pushing up soon to Flower, and producing but a few Flowers; this is acquired by their having been propagated in a dry, sandy, warm Soil.

2d, The Seed growing late, being long of pushing up the Stem, so that there is often not Time for the Seed to ripen; this is acquired by their having been propagated in a moist, stiff, cold Soil.

3d, A Disposition to grow exceedingly strong in all its Parts, in which Case too few Flowers are often produced; and this is acquired from their having been propagated in a very rich Soil.

4th, Its disposition to grow Weak, and produce small Seeds, acquired from being propagated in a poor Soil.

These affect the Grasses particularly, so that it is frequently useful to change the Seed.

Heat also prevents Moisture from rotting the Roots, or any other Part of a Plant, but it creates the Effects of most other Poisons.

PART

PART IV.

Of the NOURISHMENT of PLANTS.

A PLANT will grow in Sand alone, moistened with pure distilled Water, and in the purest Air, but not so luxuriantly as in a rich Soil.

A Plant will also grow better in a Mixture of Sand and Clay, where the Tenacity is adapted to the pushing Power of its Root, than in Sand alone; and it will also grow better if a proper Quantity of Water be applied, according to the Disposition of its Roots to resist Putrefaction, but with both these Advantages, it will not flourish so well as in a rich Soil.

If in a proper Mixture of Sand and Clay, a Plant is properly supplied with Water, it will grow better than in the same Mixture exposed to the Weather, and the Chances of being too moist or too dry; but it will grow still better in a rich Soil.

There is therefore in a rich Soil something

independant of Texture, or the Retention of Water, which contributes to the flourishing of Plants.

A Rich Soil contains Substances insoluble in Water; or Substances soluble in Water.

The Substances insoluble in Water cannot enter the Vessels of the Roots of Plants, and therefore can only contribute either to the Texture, or the production of Substances soluble in Water.

The Substances insoluble in Water may necessarily only be Sand or Clay; those at any Time found are,

Sand;

Clay;

Asbestos Talc; &c.

Calcareous Earth;

Magnesia;

Earth of Alkum;

Calces of Metals; particularly Iron

and Copper; and

The Fibres of Vegetables.

Those

Those soluble in Water that are found in all rich Soils, are

Mucilage;

Nitrous Ammoniac;

Nitrous Selenites;

Common Ammoniac;

Fixt Ammoniac;

These Substances all get into the Plant along with the Water; and the Salts are found in the Juices of the Plant, unchanged.

A mucilage is also found, but very different from that contained in Soils.

Therefore a Plant may be nourished by pure Water and Air alone; but it will be more luxuriant, if it also absorbs, and digests, a Quantity of Gelatinous Mucilage.

RICHNESS of the Soil depends on

1st A proper Degree of Tenacity, which is procured by

(a) A Mixture of Clay with Sand, or any other Earth, so that it shall contain between one Fourth of Clay, and three Fourths.

(b) Mucilage, which gives Friability to the Clay, and Tenacity to Sand.

N

(c) The

1st The Quality of the Clay, the more diffusible it is in Water, it gives the better Texture to the Soil.

2^d, The Quantity of Mucilage, the more there is in a Soil, the better.

One Grain in a Thousand will be of Advantage, as it will give a sensible Tenacity to a sufficient Quantity of Water, to moisten the Soil thoroughly.

3^d, The Quantity of Substances capable of being converted into Mucilage.

(Vide Mucilage Page 42.)

4th The Manner in the Soil disposing these to be converted into Mucilage. These

Calcareous Earth, Earthy Salts,

If a Soil be rich, a small Proportion of an Alkali, Neutral Salt, Caustic Calcareous Earth or Earthy Salt (except the Salts of Alum) will improve it; but these Substances unless they be in great Quantities, have little Effect in a poor Soil.

These Substances may be said to be Forcers, in the Clay, and Tenacity to Sand.

in as much as they not only tend immediately to produce a larger Crop, but destroy the Mucilage.

They may act by destroying the weak Fibres of the Roots, and occasioning them to push out more numerous and stronger Ones.

They may prevent the Evaporation of the Water.

They may destroy Insects.

Possibly, they may assist the Digestion of the Plant.

A very small Proportion of them, produces an Effect.

In manuring poor Soils, we are therefore to render them of a proper Texture, by adding Clay or Sand where it can be done sufficiently cheap, taking Care that they be free from Pyrites, and it is to be observed, that less Clay will be useful in sandy Soils, than Sand in Clay Soils.

FROST by the expansive Power of the Crystallization of the Water, breaks down the Masses, which form in stiff Soils.

We are to apply Gelatinous Mucilage, of Substances from whence it may be formed, or Substances forwarding the Formation of it.

(Vide Mucilage, Page 42)

These are enriching Manures.

And in rich Soils, we may venture to apply the forcing Manures, as otherwise we should not have the whole Effects of the Mucilage.

Any Defect of Texture may be made up by Mucilage, and the Alteration Clay undergoes on Culture, but the Defect of Mucilage cannot be made up by Texture.

A Soil, if it have all the Properties of a rich one, may have these counteracted by its containing poisonous Substances, which are,

1st, Metallic Salts, or Pyrites.

2d, Salts containing Earth of Allum, (or Pyrites.)

3d, Acids uncombined.

4th, Any other Salt in too large a Proportion.

The first, second and third may be destroyed by Quick Lime; the 4th is got the better of by

by Time, and the Washing the Soil with Water, by the Rains, unless there be a fresh Supply from Springs.

The Advantages of draining a Soil, are the Preventing the Water from Rotting the Seeds, and giving an Opportunity of Rotting the Roots, especially at the Time of flowering, and Taking off the Effects of the Mucilage, by too great Dilution.

The Advantages of FALLOWING are,

The Conversion of the Vegetable Fibres into Mucilage, by destroying their Life, and exposing them to the Air.

The destroying Weeds, by giving their Seeds an Opportunity of growing, killing them, and converting them into Mucilage.

The decomposing Pyrites, and Metallic and Alluminous Salts.

A very poor Soil will be but little benefited by Fallowing, in as much as there is nothing contained in it capable of being converted into Mucilage, except the Rain Water, it is better to employ an enriching Crop.

Fallowing

as Fallowing for several Years would destroy a Soil, as it would convert the whole putrescent Substances into Mucilage, and that Mucilage into Salts, and these would be decomposed.

The Advantages of DRILLING are,

The giving an Opportunity to destroy the Weeds, cut the Fibres of the Roots so as to make them branch out again, and loosen the Earth about the Roots, and throwing the Earth on the Stems, so as to make fresh Roots break out.

The saving superfluous Seed and sowing the Ground more equally.

The giving a free Passage to the Air.

It is not as yet determined how far the Rows should be from one another, nor how thick the Plants should be sown; it will require that they should be sown thinner to produce a great Crop of Seeds or Roots, than a great Quantity of Herbs.

Quest. Is there any Difference in the Direction of the Rows?

Enriching Crops are such as supply the Soil with Matters capable of being converted into Mucilage, they do this

1st, By Exudation from the Roots.

2d, By leaving the Roots, which will Putrify.

3d, If ploughed in, the whole Plant will Putrify; and it is to be observed in this Case, that the Plants should always be cut down when in full Vigour, and while the Exudation is still taking Place strongly.

If the Juices exuded are very astringent, they counteract the good Effects of this Method of Culture by preventing the Putrefaction.

A LIST OF MANURES.

These furnishing Mudilage or Substances convertible into it.

As, Ghee,
Skins,
Hair,
Hornes,
Bones,
Rags, &c. &c.
Dung of Animals,
Insects,

Manures converting into Mudilage.
Calcareous Earth, &c.
Marshy Earth, &c.
Fertile Earth, &c.
Vegetable

Vegetable putrified Substances : these go through the Saccharine, Vinous, and Acetous Fermentations first; so that a Dunghill is not sufficiently putrified, untill the Heat is over; but it is better to putrify too little, than too much, as in the first Case, the Putrefaction may be continued in the Soil; in the 2d. the Mucilage is converted into Salts, and cannot be restored.

Putrescible Vegetable Substances : it is to be observed that Vegetable Substances that are of too solid a Texture as Wood, putrify with great Difficulty into a Mucilage, and also those that have astringent Juices, and such as have lain in the Earth a considerable Time, and Sugar.

Enriching Crops.

Manures converting putrescible Substances into Mucilage.

Calcareous Earth, as

Marle,

Chalk,

Effete Lime, Earthy

Earthly Salts, in
The Dung of Fowls, Rabbits, &c.

Too putrid Dunghills,

Sea Water in small Quantity,

Forcing Manures are,

Quick Lime,

Fixt Alkali's in Vegetable Ashes,

Neutral Salts which do not assist Pu-
trification,

Earthly Salts as above.

OF INSECTS.

There are some Insects which infest Vegeta-
bles when healthy, as the Insect occasioning
the Smutt, or Blackness, in Grain, this Insect
is not destroyed by drying, but revives upon
being moistened, and if sown with the Seeds,
will be propagated over the whole Field.

21 Q. Is this to be destroyed by steeping the
Seeds in Solutions of Neutral Salts in Water?

Most Insects attack Plants, in Consequence
of a Weakness of the Plants themselves; the
Juices in that Case being converted into Sugar,
O become

Become proper Nourishment for, and attract them, but when this happens, they afterwards hurt the Plant greatly.

Each Plant is infested by its particular Insects.

PART V.

SUBSTANCES necessary for the
Examination and Analysis of SOILS,
are,

1st, **VITRIOLIC Acid,**

2d, **Muriatic Acid,**

3d, **Solution of fixt Vegetable Alkali in Water.**

4th, **Common Caustic, or Caustic fixt Vegetable Alkali.**

5th, **Caustic Volatile Alkali, or Spirit of Sal Ammoniac with Quick Lime; it is known to be Caustic by not effervescing with an Acid.**

6th, **Sal Ammoniac.**

7th, **Galls.**

8th, **Pure**

10 2d, Pure Water, if the Water contain any
 50al Metallic or Earthy Salt it is improper; to
 try this, pour into a Glass of it a few Drops
 of Solution of Fixt Vegetable Alkali in
 Water; if it be Impure, the Alkali will
 11al precipitate the Metal or Earthy such Water
 10 is to be purified by Distillation or boiling.

PROCESSES for ascertaining the Substances
 contained.

Process 1st. To ascertain the Quantity of Water.

Take 100 Grains of the Earth, spread it on
 a Stone Plate very thin before the Fire, or
 in the Sun-shine in a Warm Day; let it
 lie till it be thoroughly dry, the Water will
 evaporate, and therefore its Proportion
 will be known by the Weight lost.

2d, To know if there be any Metallic or
 Earthy Salt.

Take about a Pound of Soil, pour upon it about
 a pint of boiling distilled Water, stir them
 thoroughly together, & let them stand for 10
 Minutes, filter off the Water thorough fil-
 trating Paper, pour into what comes thro'
 a little of the Solution of the fixt Vegetable

Alkali in Water, if there be any earthy or metallic Salt, a Precipitation will take Place.

3d. To know if the Salt contained has Calcareous Earth for one of its Elements.

Take the filtrated Solution, pour into it half an Ounce of Caustic Volatile Alkali, or

continue to drop in this Alkali till no further Precipitation takes Place, afterwards

filtrate it, and pour to what filtrates thorough, a little Solution of fixt Vegetable Alkali, if

there be any further Precipitation, it shows that there is an Earthy Salt consisting of

Calcareous Earth for one of its Elements; If a Precipitation took Place upon the Ap-

plication of the Caustic Volatile Alkali, it shows that there are either other Earthy or

Metallic Salts.

4th, To know if the Salt contained be Metallic or Aluminous.

Add to the filtrated Solution an Infusion of Galls, if there be any Metallic or Alumi-

inous Salt, a Precipitation will take Place, if Iron a purplish Black, if Copper, or Allum,

a Grey.

Alkali O Copper

Copper may also be distinguished from Iron by falling in a blue precipitate upon the Application of an Alkali, while Iron forms a greenish, and Alum a white one.

5th, To know if Magnesia be an Element of the Salt found.

Take the filtrated Solution, apply to it a Solution of Galls; if no Precipitation take Place, apply Caustic Volatile Alkali, which will precipitate the Magnesia if it be an Element of the Salt contained.

6th, To know if a Neutral Salt be contained.

Evaporate the filtrated Solution with a boiling heat, till the whole Water is nearly gone off, and let it stand to cool. If there be any Neutral Salt, it will crystallize.

7th, To know if there be any Mucilage and what Quantity.

Take 30 or 40 Pounds of the Soil, boil it in 10 Gallons of Water for an Hour, let the Earth subside, pour off the clear Solution, afterwards add four or five Gallons of Water to the Earth, stir them thoroughly, let them stand to subside, pour off the Water clear, mix it with the former, and evaporate

potate the whole to dryness, putting it into
 a Water Bath towards the End of the Eva-
 poration, what remains is the Mucilage,
 making Allowance for that part of the De-
 coction which was not washed out from the
 Earth, and deducting the Saline Substances,
 which will crystallize if there be a confi-
 derable Quantity; but will be destroyed in
 the Operation if in small Proportion, as
 they generally are.

8th, To know if there be any Calcareous Earth
 in the Soil, and what Quantity.

Take 1000 Grains of the dry Soil, apply
 to it half an Ounce of Muriac Acid and
 four Ounces of Water in a Glass, Stone
 Ware, or Porcelaine Vessel, sufficiently
 large; let them stand together till no more
 Effervescence takes place; and if it was
 very considerable, pour in half an Ounce
 more of the Acid, let this stand also till the
 Effervescence ceases, if any arose upon
 pouring it in, continue to add more
 Acid in the same Manner, until what was
 poured in last, produces little Effervescence,
 which is often at the first, and generally
 at the 2d or 3d half Ounce. Af-

After the Effervescence has ceased, put the whole in a Filter, let the Solution filtrate thorough; pour half a pint of Water upon what remains in the Filter, let that filtrate also into the same Vessel; add to the Solution thus filtrated an Ounce and an Half of Caustic Volatile Alkali for every Ounce of Acid used; if any Precipitation take Place, there is Magnesia, Earth of Allum, or the Salt of a Metal (generally Iron or Copper) contained in the Soil; after adding the Volatile Alkali the whole is to be thrown into a filter again, after the filtration has taken Place, pour into the Liquor a Solution of mild fixt Vegetable Alkali in Water, if there be any Calcareous Earth in the Soil, a Precipitation will take Place; continue to add the Solution of the Alkali till no fresh Precipitation ensues, throw the whole into a Filter, let the Liquor filtrate off, pour on by Degrees a Pint of Water, let that filtrate off also; dry what remains in the Filter, it is the Calcareous Earth.

9th, To know the Proportions of Sand and Clay.

Take

Take what remains in the Filter after the first Solution in the foregoing Operation, and by Elutriation separate the Sand from the Clay, dry and weigh them: If there be any Pyrites it will appear in the Sand.

In the Above Processes the Principal Things to be attended to, are,

Whether there be any Metallic, or Aluminous Salts, as these are absolute Poisons, and therefore are to be decomposed by Quick-lime.

Whether there be such a Proportion of Neutral or Earthy Salts as to be hurtful, in which Case, the Solution in Process (2d,) will taste Salt, a Soil containing them in so large a Proportion, will hardly ever admit of Culture for Grain.

Whether there be Calcareous Earth, and in what Proportion, as that ascertains the Propriety of applying any Manure containing it, and the Quantity of that Manure.

To know the Proportions of Sand and Clay.

Take

EXPLANATION

What the Proportion of Sand and Clay is, which ascertains the Propriety of adding Sand or Clay.

PLATE III.

Whether there be Pyrites as that shows why, and when a Soil will be long of being brought into Cultivation.

Pyrites are best destroyed by following the following Experiment it is found that Bodies upon cooling contract and retain their Shape; therefore that they contract in every Direction.

Suppose A A A B B B to represent the Section of a Sphere, the Diameters A B upon the Sphere's being cooled, become equally shorter in all their Parts; but if the Particles lying in the Direction of these Diameters touched, they could not come nearer, and the Diameters could not contract. As therefore they are actually found to contract, it is evident that the Particles do not touch.



FIG. III.

The Particles O O of the Oil, attracting one another stronger than they do the Particles W W of the Water, form a Globule G G surrounded by the Particles W W of the Water.

FIG.



EXPLANATION

PLATE II.

FIG. II.

FROM Experiment it is found, that Bodies upon cooling contract and retain their Shape; therefore that they contract in every Direction.

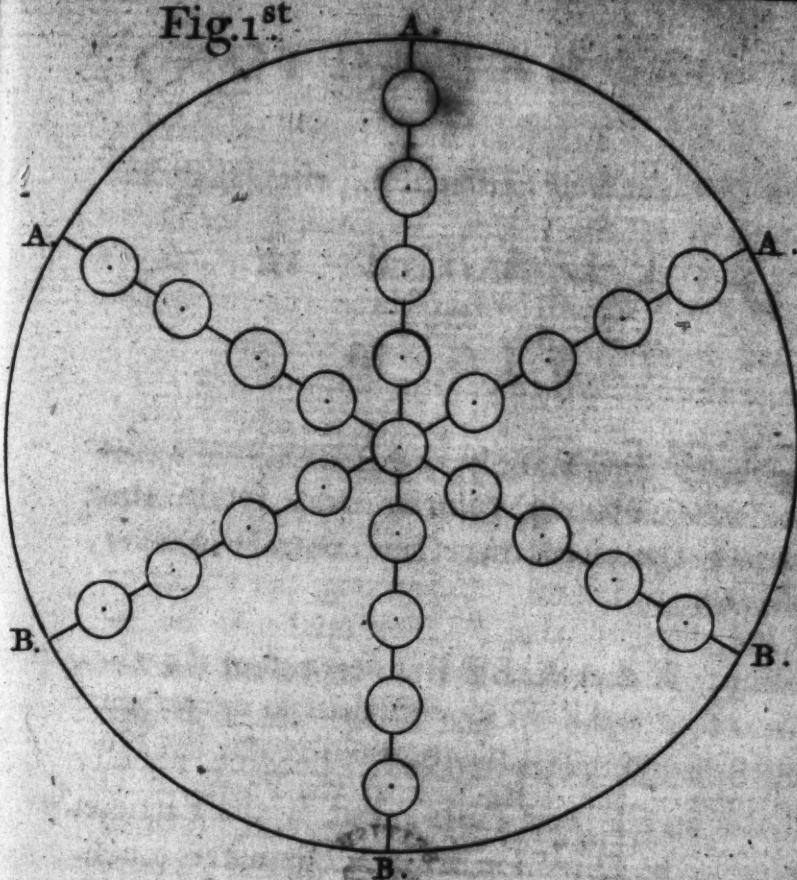
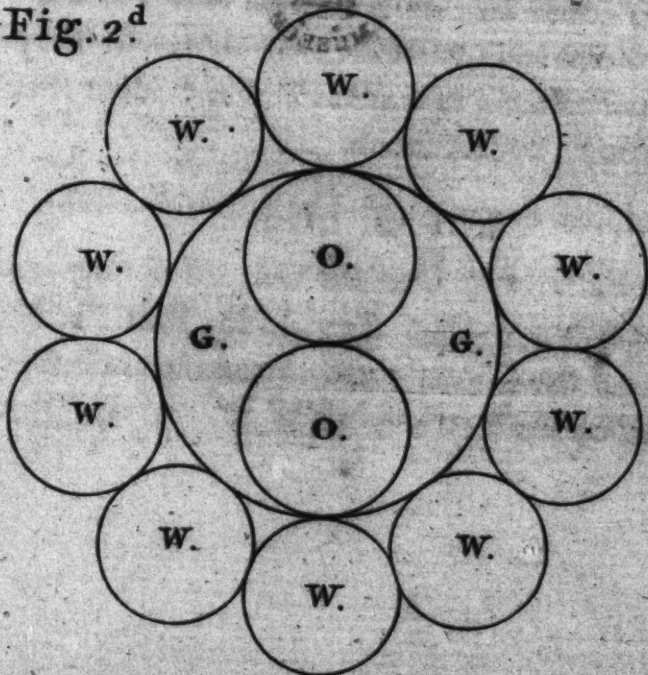
Suppose A A A B B B to represent the Section of a Sphere, the Diameters A B upon the Sphere's being cooled, become equally shorter in all their Parts; but if the Particles lying in the Direction of these Diameters touched, they could not come nearer, and the Diameters could not contract. As therefore they are actually found to contract, it is evident that the Particles do not touch.

FIG. II.

The Particles O O of the Oil, attracting one another stronger than they do the Particles W W &c. of the Water, form a Globule G G. surrounded by the Particles W W &c. of the Water.

FIG.



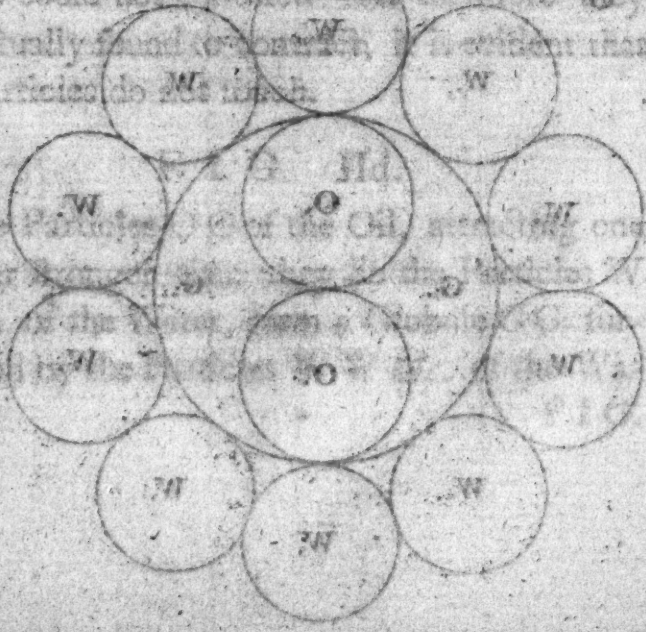
Fig. 1stFig. 2^d

EXPLANATION

PLATE II

FROM Experiment it is found, that Bodies upon which no force is exerted, remain in their Situation, and that the contrary is every Direction.

Suppose A A A B B B to represent the Section of a Sphere, the Diameter A B upon the Sphere being fixed, becomes actually fix'd in all those Parts, but if the Particles being in the Direction of the Attraction attached, they could not come together, and the Diameter could not contract, it is evident that the Particles do not attract.



The Particles of the Oil are not only attracted to the Glass, but also to each other, and the Particles of the Water are attracted to the Particles of the Oil.

EXPLANATION OF PLATE III.

FIG. III.

The Particles S of the Serum, and the Particles W of the Water, as strongly as they do one another, they intermix together equally.

FIG. IV.

Suppose N a Sphere of Iron immersed in Water, it would be surrounded by the Particles of Water W &c in order to sink through the Water it must separate the Particles D from one another, and therefore must overcome their Attraction, and it must slide along the Particles C B and therefore that Friction must also be overcome. If therefore the Difference of specific Gravity should not be sufficient to overcome these Resistances, the Sphere would swim. But the Resistance of the Attraction of the Particles D will be the same nearly in a large and a small Sphere, and the total Difference of the Gravity of a small Sphere and an equal Bulk of the Fluid will be less than the total Difference of the Gravity of a large Sphere and an equal Bulk of the Fluid; if therefore you could diminish the Attraction until that Difference is less than the Attraction of the Particles D, it would swim.

FIG. V.

As the Particles of Bodies do not touch but adhere by Attractions, and Repulsions, they may be considered as acting at the Sphere, where their Attractions are the greatest. If there be four Particles P P P P, they may be considered as producing their Effects at the Sphere.



EXPLANATION of P L A T E IIId.

F I G. IIIId.

The Particles S of the Serum, attracting the Particles W of the Water, as strongly as they do one another, they intermix together equally.

F I G. IVth.

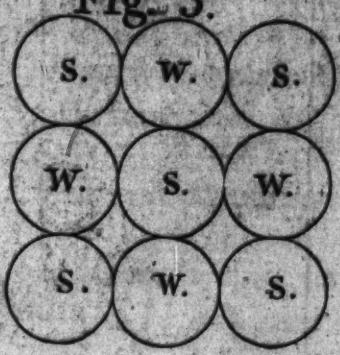
Suppose N a Sphere of Iron immers'd in Water, it would be surrounded by the Particles of Water W W &c. in order to sink through the Water it must separate the Particles D D from one another, and therefore must overcome their Attraction, and it must slide along the Particles C B and therefore that Friction must also be overcome. If therefore the Difference of Specific Gravity should not be sufficient to overcome these Resistances, the Sphere would Swim. But the Resistance of the Attraction of the Particles D D will be the same nearly in a large and a small Sphere, and the total Difference of the Gravity of a small Sphere and an equal Bulk of the Fluid, will be less than the total Difference of the Gravity of a large Sphere and an equal Bulk of the Fluid; if therefore you could diminish the Sphere untill that Difference is less than the Attraction of the Particles D. D. it would swim.

F I G. Vth.

As the Particles of Bodies do not touch but adhere by Attractions, and Repulsions, they may be considered as acting at the Sphere, where their Attractions are in Equilibrio. If there be four Particles P P P P, they may be considered as producing their Effects at the Spheres A A A A.



Fig. 3.



A Fig. 5. A

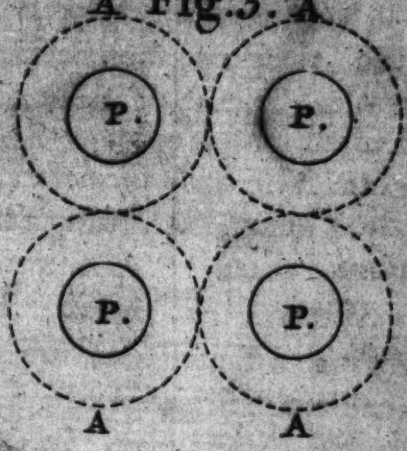
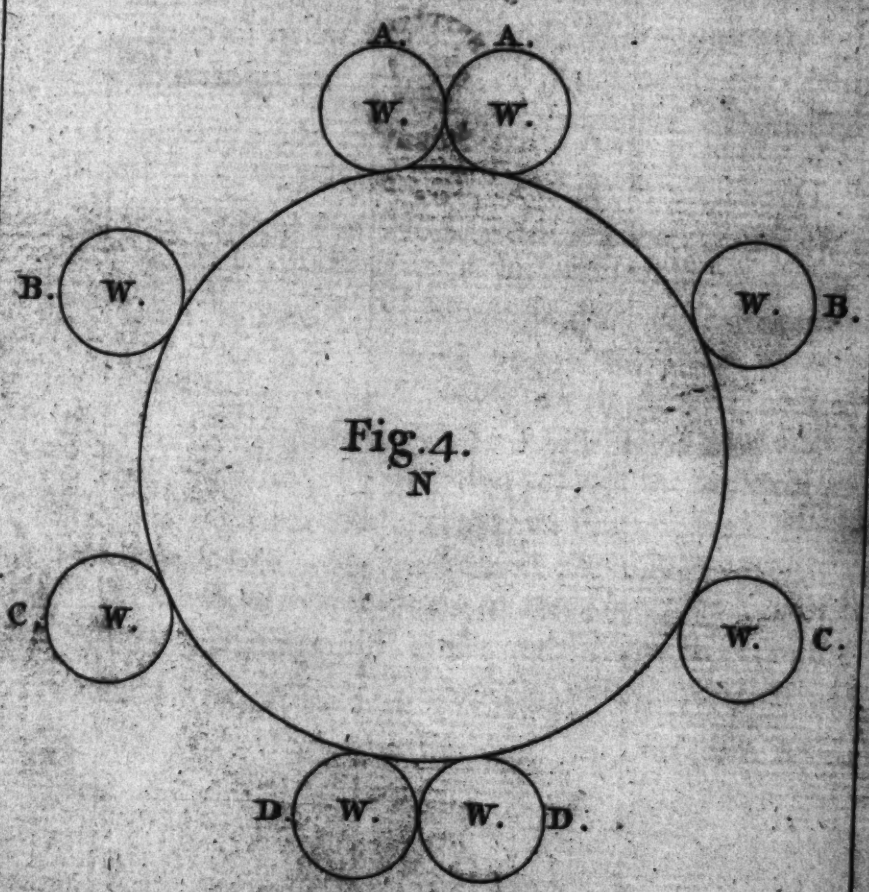
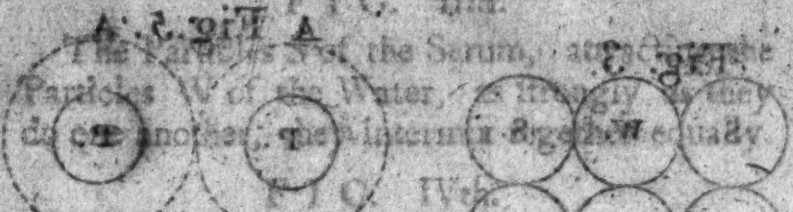


Fig. 4.
N



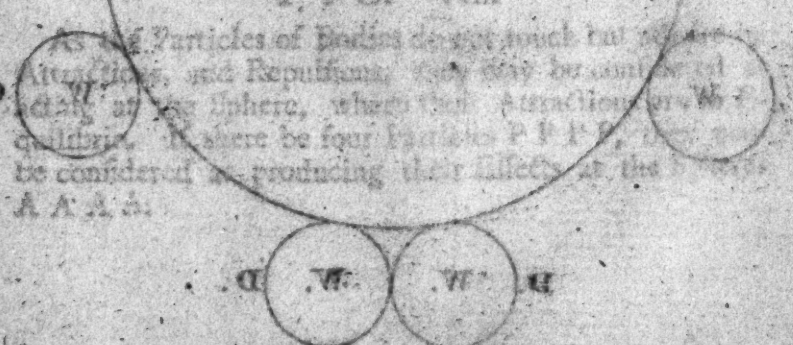
EXPLANATION OF PLATE III.

FIG. III.



The Particles A of the Serum, and C of the Water, are equally heavy, and are equally attracted by the Particles B, D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z. Suppose now a Sphere of Iron immersed in Water, it would be surrounded by the Particles of Water, and in order to sink through the Water, it must separate the Particles D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z from one another, and therefore must overcome their Attraction, and it must slide along the Particles C, B, and therefore that Friction must also be overcome. If therefore the Difference of Specific Gravity should be sufficient to overcome these Resistances, the Sphere would swim. But the Resistance of the Attraction of the Particles D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z will be the same nearly in a large and a small Sphere, and the total Difference of the Gravity of a small Sphere and an equal Bulk of the fluid will be less than the total Difference of the Gravity of a large Sphere and an equal Bulk of the fluid; if therefore you could diminish the Sphere until that Difference is less than the Attraction of the Particles D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, it would sink.

FIG. Vth.



EXPLANATION of P L A T E III.

F I G. VIII.

When two Particles P are chemically combined, they may be considered as united at the chemical Sphere of Action C, and now to have acquired one common Sphere of Mechanical Action M, their former Spheres of Mechanical Action being lost during their chemical Combination.

F I G. VIII.

Thus a Particle of Volatile Alkali, may unite chemically with a Particle of an Acid, forming Sal Ammoniac, in which they have one common Sphere of Chemical Attraction, at which they may unite with Copper, and when so combined, the three Particles acquire one Sphere of Mechanical Action.

F I G. VIII.

Substances evaporate more or less readily according to the Pressure on their Surface; suppose therefore, that a Fluid consists of Rows of Particles A B C the upper Row A has only the Pressure of the Atmosphere, but the next Row B, has both the Pressure of the Atmosphere, and the Pressure of the upper Row, therefore the upper Row A will evaporate most readily, and as boiling Fluids are heated equally, and it will require a greater Heat to evaporate the Row B than the Row A. the whole Evaporation will take place from the Surface.

EXPLANATION of P L A T E III.

F I G. VIth.

When two Particles P P are chemically combined, they may be considered as united at the chemical Sphere of Action C, and now to have acquired one common Sphere of Mechanical Action M, their former Spheres of Mechanical Action being lost during their chemical Combination.

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F I G. VIII.

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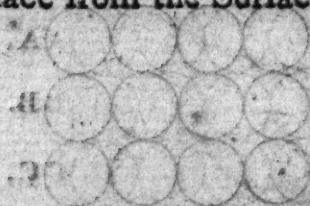


Fig. 6.th

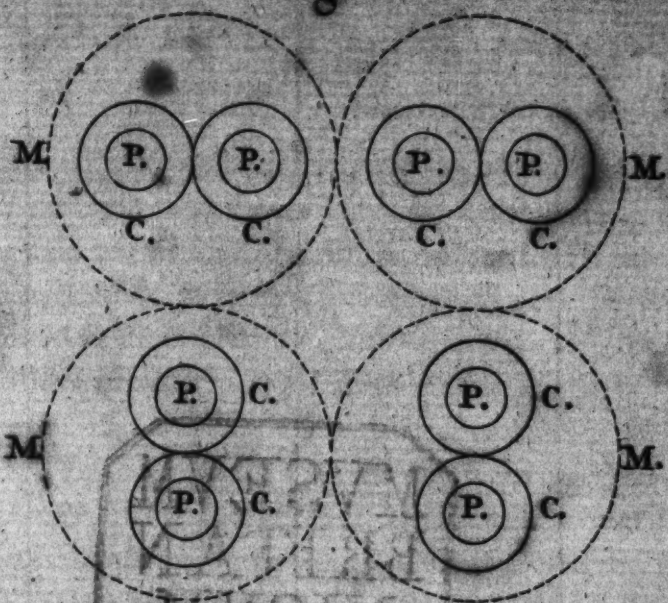


Fig. 7.th

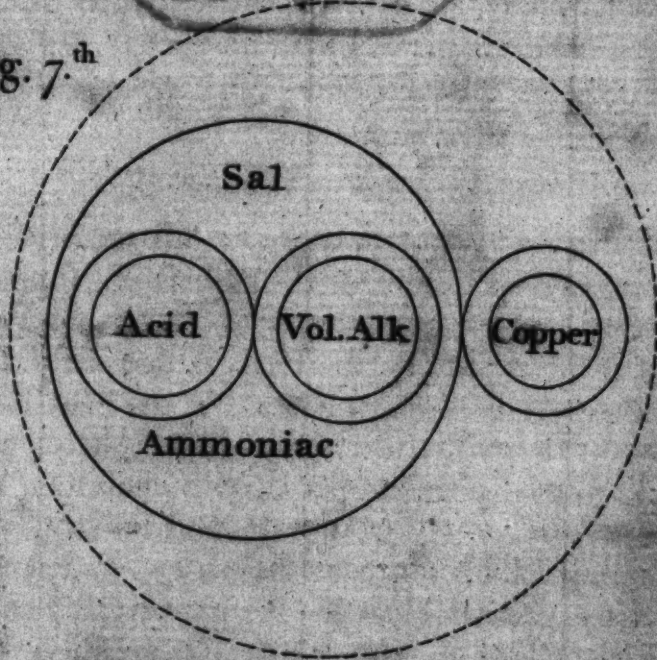
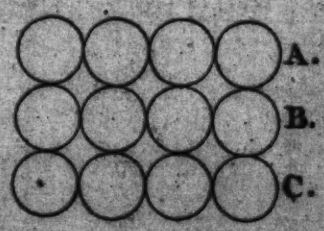


Fig. 8.th



EXPLANATION OF PLATE III.

FIG. 1.



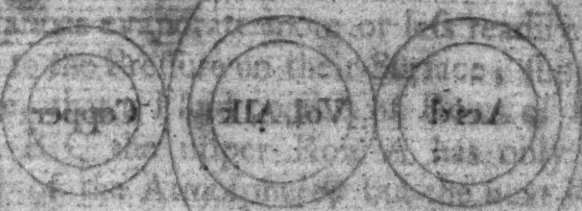
hibited, the only difference being, that in the chemical Sphere of Action C and D have retained one common Sphere of Mechanical Action M. These former Spheres of Mechanical Action being distinguished by a Chemical Combination.

M.



Thus, the four Spheres of Action, which unite chemically, and form the common Sphere of Mechanical Action, they may unite with each other, and form the three Parts of the Mechanical Sphere.

FIG. 2.



Substances, which are united chemically, and form the common Sphere of Mechanical Action, they may unite with each other, and form the three Parts of the Mechanical Sphere.

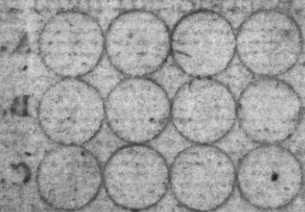


Fig. 3.

